



## Original communication

## Injuries over neck in hanging deaths and its relation with ligature material: Is it vital?



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## ABSTRACT

Hanging is a common suicidal means adopted. Careful inspection and noting of ligature mark is a vital factor during medico-legal postmortem. Ligature material used by the deceased is an important factor causing ligature mark in hanging. Apart from the ligature mark there are other injuries over neck surrounding it, which are called as 'peri-ligature injuries'. Peri-ligature injuries such as blisters, bruise, abrasion, etc. are influenced by different types of ligature material involved. These peri-ligature injuries are important for commenting on the antemortem nature of hanging in addition to other factors. Thus the present study on hanging deaths was carried out to see the relation of ligature material and different injuries occurring over the neck.

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## 1. Introduction

Many studies regarding deaths by hanging were done by different researchers. Very few studies have regarded relation of ligature material and surface injuries over neck, in particular the peri-ligature injuries.<sup>1–3</sup> Several details concerning with ligature material used and ligature marks also require particular consideration. Peri-ligature injuries such as blisters/rope burn, ecchymosis, abrasion can be seen. However, these injuries need special attention with reference to nature, location, distribution, and pattern. In cases of hanging apart from giving an opinion as to the cause of death, the postmortem doctor has to comment on the nature of hanging being antemortem or post-mortem? A mark of saliva dribble is a classical feature of antemortem hanging, but it may not always be present in all cases. The reason for this is due to wiping of mouth by relatives or doctors in an effort for resuscitation. Some other features like peri-ligature injuries can also aid a medico-legal person to

comment upon the antemortem nature of hanging.<sup>1,2</sup> The present study was undertaken to ascertain various types of surface injuries over neck and to study them in relation to the ligature material.

## 2. Material and method

A prospective study of deaths due to hanging was studied. A total 80 bodies of hanging related deaths brought for medico-legal autopsy in the Department of Forensic Medicine, Government Medical College, Nagpur between period of Jan 2009 to December 2009 were studied with a view to assess the information that a ligature mark can provide in such deaths. Out of the 80 cases studied 54 were males and 26 were females. Age group of the study sample ranged from 1.5 years to 65 years.

Information regarding the incident, age, sex, type of ligature material and injuries in the form of ligature mark and peri-ligature injuries were obtained during postmortem examination. Cases brought in a decomposed state were excluded. Different types of ligature material were studied in relation to ligature mark and other injuries over the neck. Peri-ligature injuries were classified as blisters, abrasions and ecchymosis.

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**Table 1**  
Ligature material used in cases of hanging.

Ligature material	Cases (n = 80)	%
Nylon rope	26	32.5
Odhni	18	22.5
Dupatta	14	17.5
Cotton rope	10	12.5
Saree	09	11.2
Electric wire	01	1.2
Newar patti	01	1.2
Plastic pipe	01	1.2

### 3. Results

#### 3.1. Types of ligature material

Different types of ligature material were used for hanging. Nylon rope (32.5%) was the commonest type of ligature material used, followed by odhni (22.5%), dupatta (17.5%) and saree (11.2%) while electric wire (1.7%), newar patti (1.7%), and plastic pipe (1.7%) were rarely used (Table 1).

Odhni is a Traditional long rectangular piece of cloth (multi-purpose scarf) worn across both shoulders and can be worn like a cape around the entire torso and around neck by Indian Female. Dupatta is a Traditional long rectangular piece of cloth (multi-purpose scarf) worn over head, across both shoulders and can be worn like a cape around the entire torso and neck by Indian Female and Indian Males. Saree (sari) is a strip of unstitched cloth, worn by women, ranging from four to nine yards in length that is draped over the body in various styles which is native to the Indian Sub-continent. Newar patti is nylon or cotton made roll which is used to wove and make charpai (traditional Indian wooden/metal frame woven bed).

#### 3.2. Position of ligature mark

As shown in Table 2, the ligature mark was complete in 16.25% cases and was situated above the level of the thyroid cartilage in 86.2% cases. The mark was single in 96.2% and obliquely placed in 92.5% cases. The grooving was present in 53.7% and imprint of ligature material was noticed in 32.5% cases.

#### 3.3. Peri-ligature injuries

As per Table 3, the peri-ligature injuries in the form of blister, abrasion or ecchymosis were present in 14 cases (17.5%) of hanging. Out of these 14 cases of peri-ligature injuries, the blisters were noticed in 28.5% (Fig. 1), ecchymosis in 50% (Fig. 2) and abrasion in

**Table 2**  
Characteristics of ligature mark found.

Ligature mark	Cases (n = 80)	%
Mark	Complete	13
	Incomplete	67
Loops	Single	77
	Multiple	3
Levels	Above thyroid	69
	At level of thyroid	8
	Below level of thyroid	3
Position	Obliquely placed	74
	Transversely placed	6
Grooving of ligature	Absent	43
	Present	37
Imprint of ligature	Absent	54
	Present	26

**Table 3**  
Different types of peri-ligature injuries.

Peri-ligature injuries (Total = 14 cases)	No.	%
Blisters	04	28.5
Ecchymosis	07	50
Abrasions	08	57.1

57.1% case (Fig. 3). Peri-ligature blisters were mostly seen above the ligature mark, except in one case where it is present on both sides. Peri-ligature ecchymosis were present on both sides of ligature mark in all the seven cases but in one case of multiple turns, ecchymosis was also present in between the ligature mark. Peri-ligature abrasions were usually found below the ligature mark in all cases due to slippage of ligature material. But in one case the abrasion was also noticed just above the ligature mark probably due to rubbing of neck fold to the rough surface of ligature material (nylon rope). The total abrasions mentioned are only due to slippage of ligature and not due nail scratches.

#### 3.4. Pattern of ligature mark

As per Table 4, the ligature mark was grooved in almost all cases of hanging with nylon rope, electric wire and plastic pipe. Thus, the grooving was seen in rough and tough type of ligature material (Fig. 4). However, it was also seen in 33.3% cases of hanging with cotton rope, 22.2% in odni, and 14.2% in dupatta. Similarly the peri-ligature injuries was seen 34.6% cases of hanging with nylon rope, 16.6% in odni, 10% in cotton rope, and 7.1% in dupatta.

#### 3.5. Peri-ligature injuries in relation with ligature material

On studying different peri-ligature injuries in relation to ligature material blisters, ecchymosis, and abrasion was seen in 15.4% each in cases of hanging with nylon rope. However, abrasion was also seen in 16.7% and 7.1% cases with odni and dupatta respectively and ecchymosis in almost 10% each in cases with odni and cotton rope (Table 5).

### 4. Discussion

Most of the times, the ligature mark may be the only evidence available in cases of hanging. Thus, it is crucial diagnostic importance to examine the ligature mark in detail with regards to its course, depth, and pattern. The appearance of ligature mark at autopsy depends on the nature and texture of ligature material.

**Fig. 1.** Peri-ligature blisters by rough and tough ligature material like nylon rope.

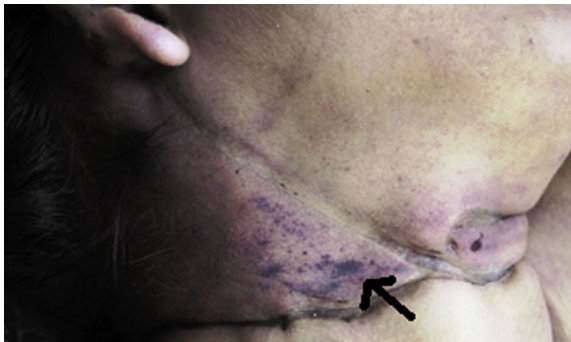


Fig. 2. Peri-ligature ecchymosis by rough and tough ligature material like nylon rope.



Fig. 4. Grooving of ligature mark by narrow rope.

In the present study, nylon rope was the commonest type of ligature material followed by odhni, dupatta and saree. It may be due to easy availability of such material in the household and non-complexity in its making. The findings are consistent with that of Sharma et al.,<sup>3</sup> Dixit et al.,<sup>4</sup> and Pradhan et al.<sup>5</sup> In the western countries the main ligature material were rope/cord, belt, electric cables and dog leads.<sup>6,7</sup> However Saisudhir,<sup>8</sup> Ahmed,<sup>9</sup> and Patel<sup>10</sup> noted dupatta as the commonest ligature material involved, being a common clothing attire of the females in that region.

The ligature mark was usually incomplete and situated above the level thyroid cartilage. It has been usually single and obliquely placed over the neck. These findings are consistent with that of other authors.<sup>3,4,7,8,10–13</sup> The grooving was present in 54% with imprint in 32.5% cases. The grooving was seen in all cases of hanging with the hard ligature material. The findings were similar to that of other studies.<sup>3,7,8</sup> Sometimes the groove retains the pattern of the ligature material, e.g., a spiral weave of the rope.<sup>14</sup> Again the narrower and harder the ligature material, and longer



Fig. 3. Peri-ligature abrasion by rubbing of neck-fold with ligature material.

**Table 4**  
Ligature material in relation with ligature mark and peri-ligature injuries.

Ligature material	Grooved ligature mark	%	Peri-ligature injuries	%
Nylon rope (n = 26)	26	100	9	34.5
Odhni (n = 18)	4	22.2	3	16.6
Dupatta (n = 14)	2	14.2	1	7.1
Cotton rope (n = 10)	3	33.3	1	10
Saree (n = 9)	0	0	0	0
Electric wire (n = 1)	1	100	0	0
Newar patti (n = 1)	0	0	0	0
Plastic pipe (n = 1)	1	100	0	0

the suspension time, more detectable is the grooving of ligature mark.

One of the important aspects in hanging deaths is to ascertain the nature of hanging being antemortem or postmortem. Features like a saliva dribble mark are suggestive of antemortem hanging. However, due to wiping of mouth by relatives or doctors in the efforts of resuscitation it may be usually absent. In such case from other features of ligature mark like peri-ligature injuries, a medico-legal person can comment upon the antemortem nature of hanging. In our study, peri-ligature injuries were commonly associated with rough and tough ligature material like nylon rope followed by odni, cotton rope, and dupatta. Peri-ligature blisters were only seen with nylon rope while peri-ligature ecchymosis and abrasion was commonly seen in nylon rope followed by odni.

Peri-ligature blisters also known as rope burns are produced by rough and tough ligature material like coir or nylon rope due to friction of rope against skin that generates considerable heat, which will produce blisters by expressing tissue fluid into the upper layers of skin.<sup>2</sup> Blisters containing serum may result from the friction of a tight noose against skin.<sup>15</sup> Constriction of the neck in the noose sometimes causes pinching of the skin and vertical folds, which rubs against the noose, and become abraded. In hanging when the loop gets pulled upwards due to the weight of the body below the neck, sometimes causes abrasions directed upwards towards the ligature mark known as the 'evidence of slippage of ligature material' which is considered as a sign of antemortem hanging.<sup>16</sup> However, abrasions in hanging may not be antemortem always as in case of prolonged suspension if there is slippage of ligature after death there may be postmortem abrasions.<sup>11</sup>

In cases of hanging where there is much movement between the neck and the rope before death the skin may be abraded.<sup>17</sup> There may be narrow hemorrhagic border into parts of ligature marks. The victim might pluck at the ligature and if he had long nails he could then abrade skin.<sup>11</sup> Multiple ecchymotic areas found above

**Table 5**  
Different peri-ligature injuries in relation with ligature material.

Ligature material	Blister	%	Ecchymosis	%	Abrasion	%
Nylon rope (n = 26)	4	15.3	4	15.3	4	15.3
Odhni (n = 18)	0	0	2	11.1	3	16.6
Dupatta (n = 14)	0	0	1	10	0	0
Cotton rope (n = 10)	0	0	0	0	1	7.1
Saree, electric wire, newar patti, and plastic pipe (n = 12)	0	0	0	0	0	0



the ligature mark may be postmortem however when they are present below the ligature mark they are invariably antemortem in nature.<sup>16</sup> This is because an ecchymosis seen above ligature mark may be more influenced due to engorgement of blood vessels due to stasis caused by the ligature material leading to its rupture. However, the ecchymosis present below the ligature mark will not be so much influenced by such mechanism, hence it is more likely to be of antemortem nature.

Ecchymosis alone has no significance to whether the hanging was caused during the life or not but abrasions with hemorrhagic areas are strongly suggestive of it having taken place during the life.<sup>18</sup> This is commonly caused by the attempts of the victim to pull away the ligature. The factors for the production of various abrasions, bruises being the nails of the struggling victim to free himself, fibers projecting from the material and the knot of the ligature material.<sup>2</sup> Our study systematically analyzed the occurrence of ligature mark along-with different peri-ligature injuries in relation with ligature material. However, it requires a very meticulous examination as they may get easily missed. Thus, the present study has revealed the importance of identifying such injuries and its relation to ligature material.

#### Ethical approval

None.

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#### Conflict of interest

The authors have no conflict of interest.

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